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Title: MULTI-STAGE HEAT ABSORBING
REACTOR AND PROCESS FOR SCR OF NOX
AND FOR OXIDATION OF ELEMENTAL
MERCURY

Inventor's Name: J. Edward CICHANOWICZ

Application No.: New Patent Application

Docket No.: 023407-00001

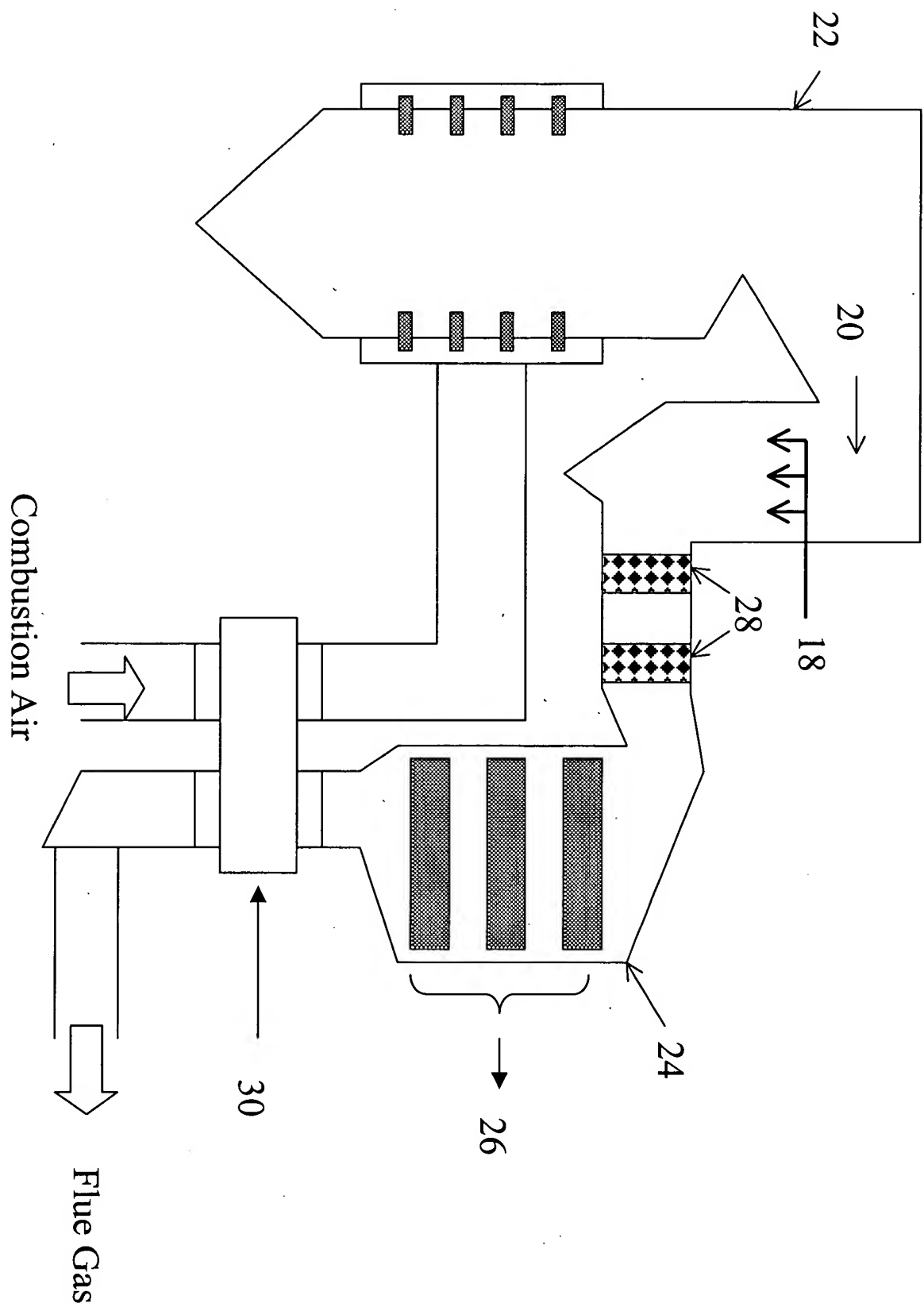


Figure 1: Conventional SCR Process Arrangement

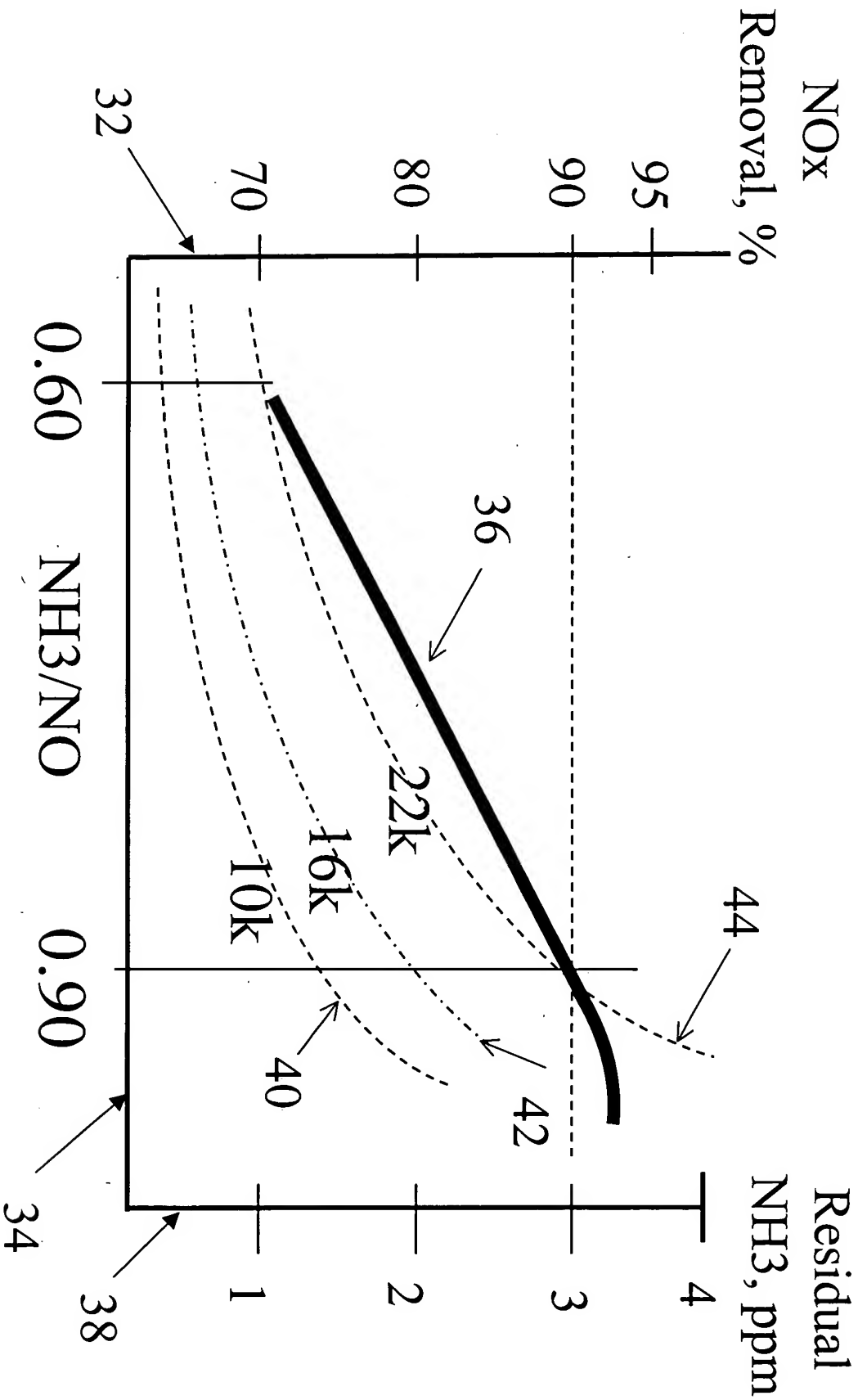
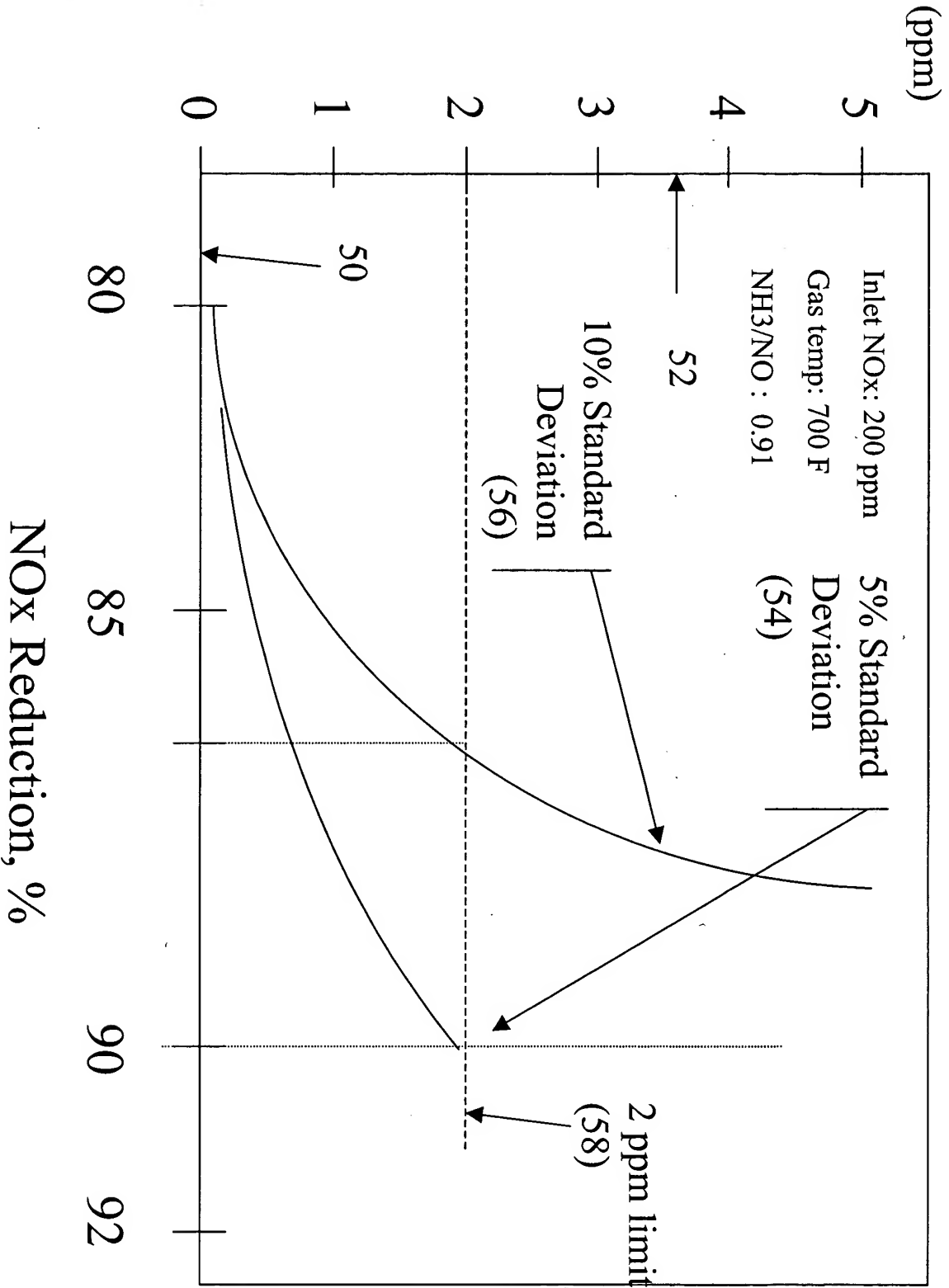


Figure 2: Typical SCR NOx Removal and Residual NH3

Figure 3: NH3/NO Ratio Non-Uniformity Effects
on NOx Removal Performance



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FIGURE 4: SCR PROCESS CONDITIONS ACROSS THE REACTOR
AND EACH OF THREE CATALYST LAYERS

| | NOx Removal (%) | NOx (ppm) | NH3 (ppm) | Overall NH3/NO Ratio | NH3 Deviation (ppm) | NH3/NO Standard Deviation Entering Layer | SO3 Created by SCR (ppm) | ABS Onset Temp, F |
|---------------|-----------------------|--------------|--------------|----------------------------|---------------------------|---|-----------------------------------|-------------------------|
| Process Inlet | | 200 | 182 | 0.91 | 9 | 5% | 15 | 575 |
| Layer 1 | | | | | | | | |
| Across | 68% | 136 | 136 | | | | | |
| Exit | | 64 | 46 | 0.72 | 9 | 14% | 21 | 450 |
| Layer 2 | | | | | | | | |
| Across | 19% | 38 | 38 | | | | | |
| Exit | | 26 | 8 | 0.31 | 9 | 35% | 31 | 430 |
| Layer 3 | | | | | | | | |
| Across | 3% | 6 | 6 | | | | | |
| Exit | | 20 | 2 | 0.10 | 9 | 46% | 45 | 375 |

Figure 5: The Influence of Gas Temperature on SO₂ Oxidation

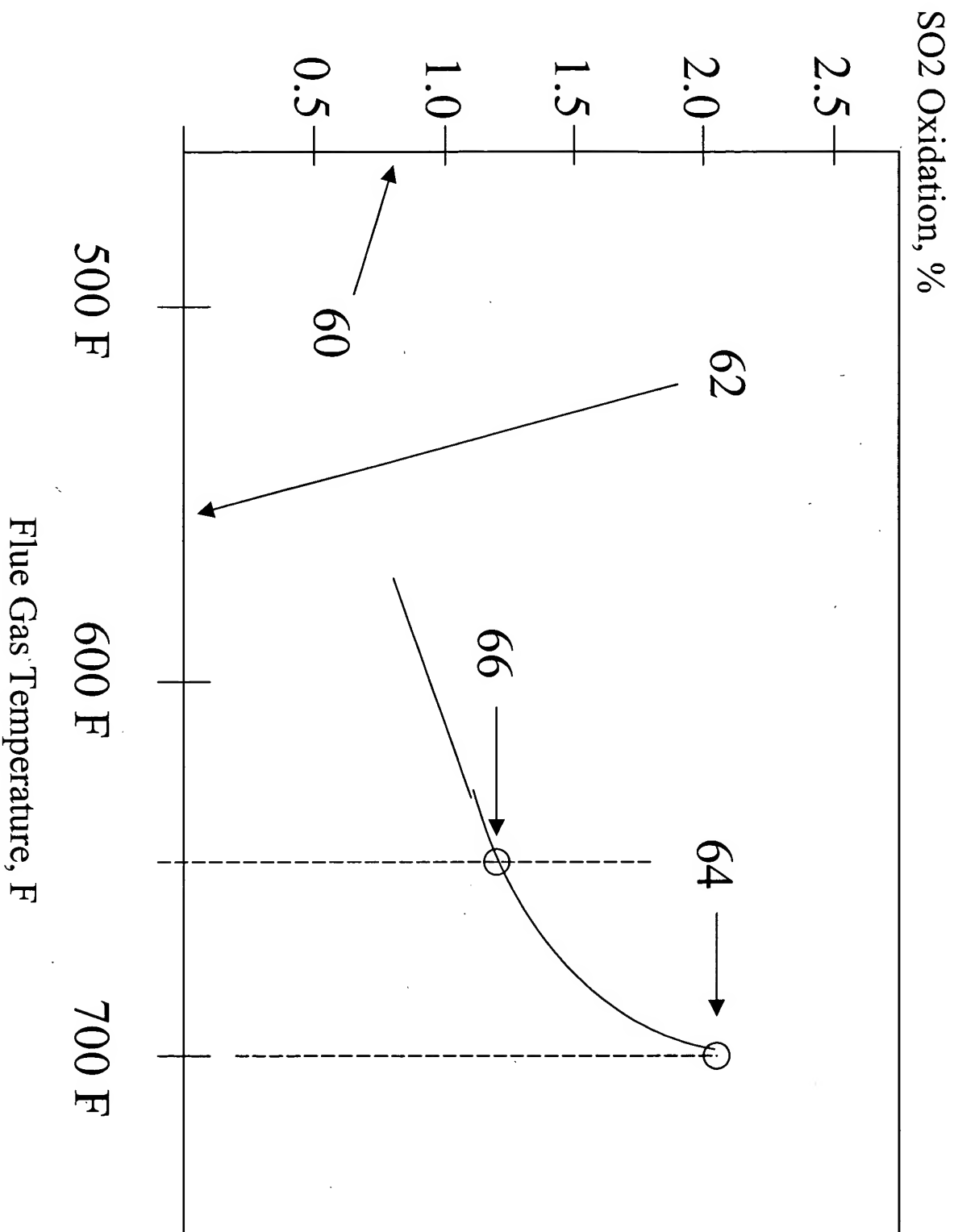


Figure 6: SO₂ Oxidation As a Function of NH₃/NO Ratio

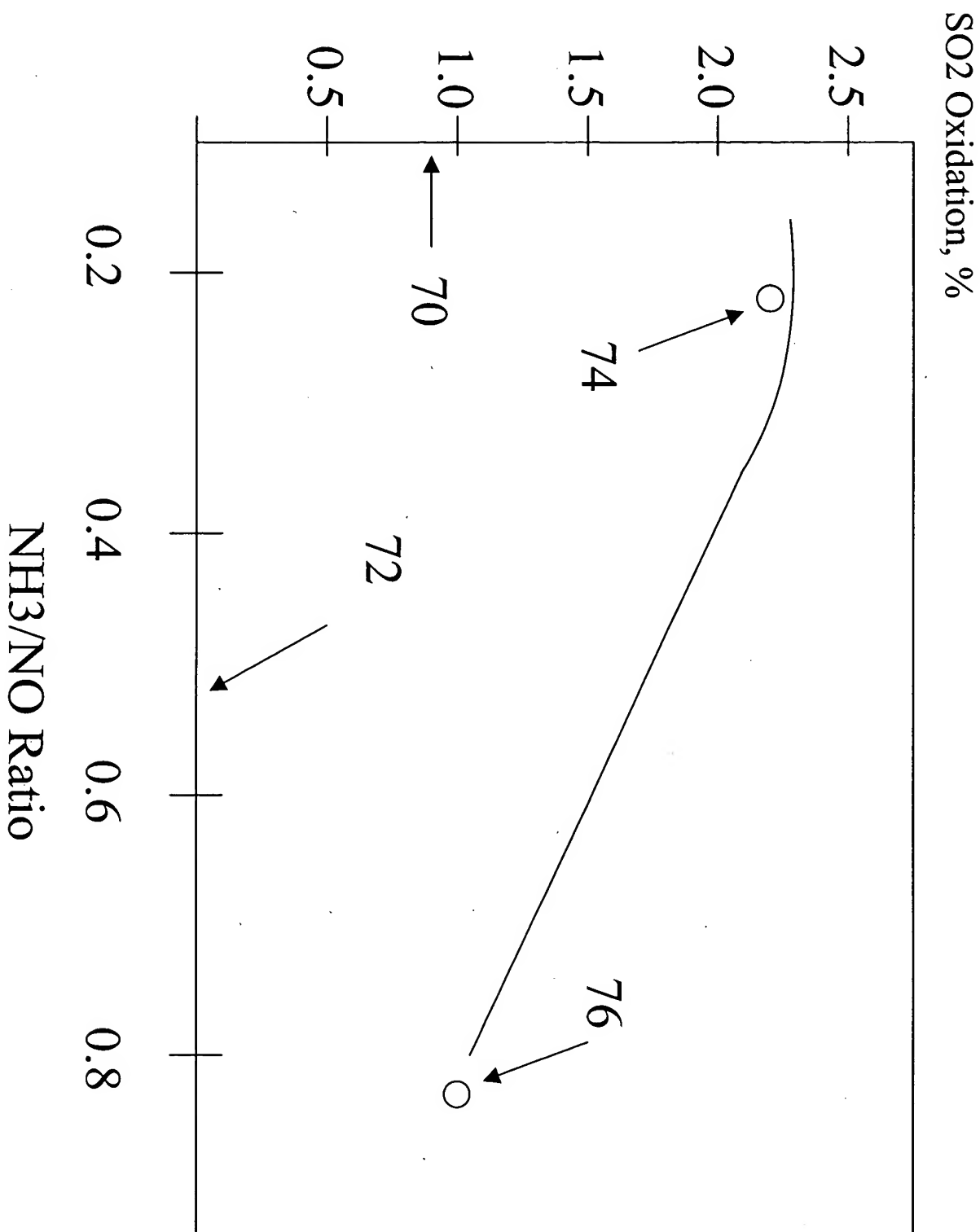


Figure 7: Conventional Ljungstrom-type Air Heater

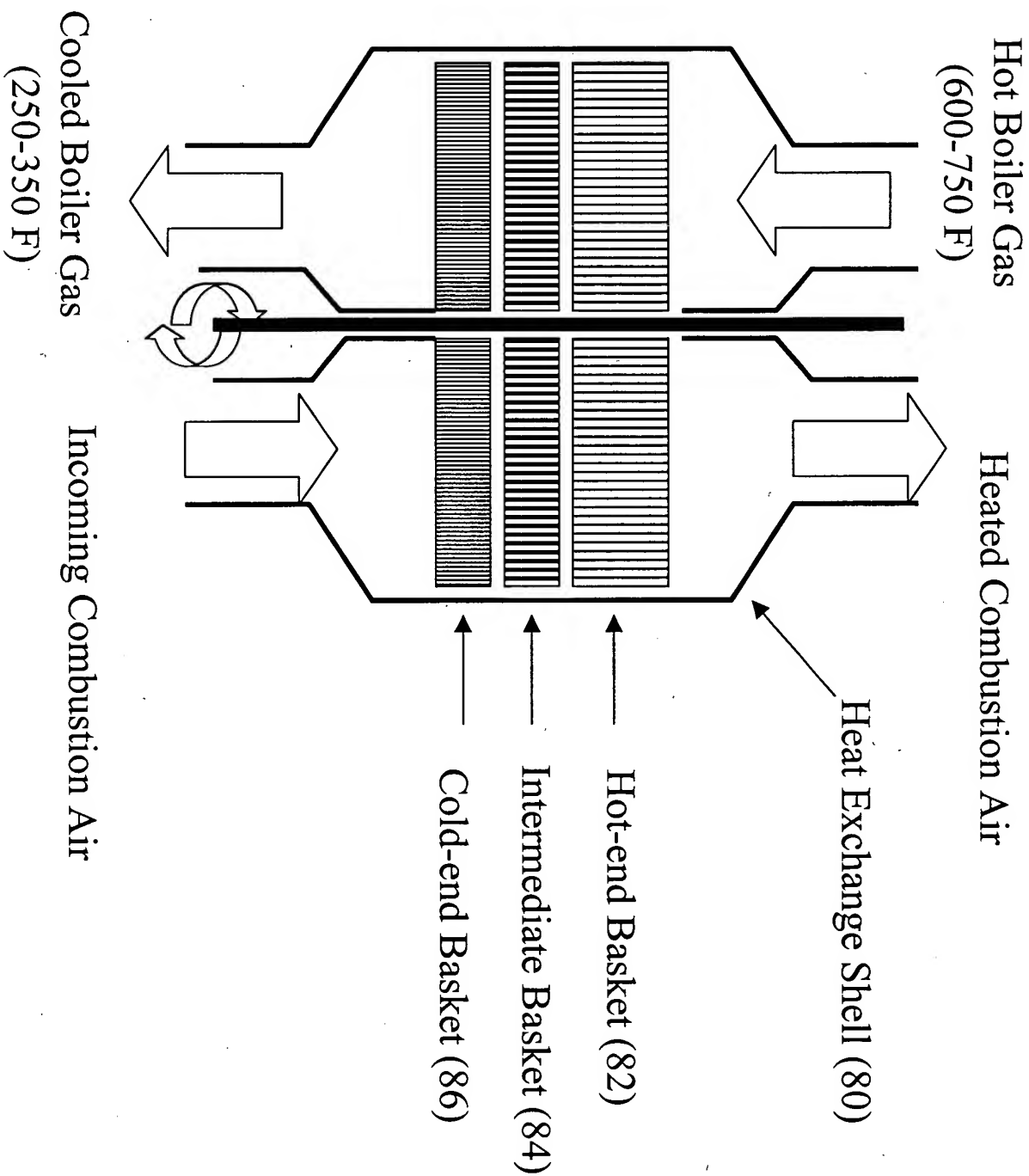
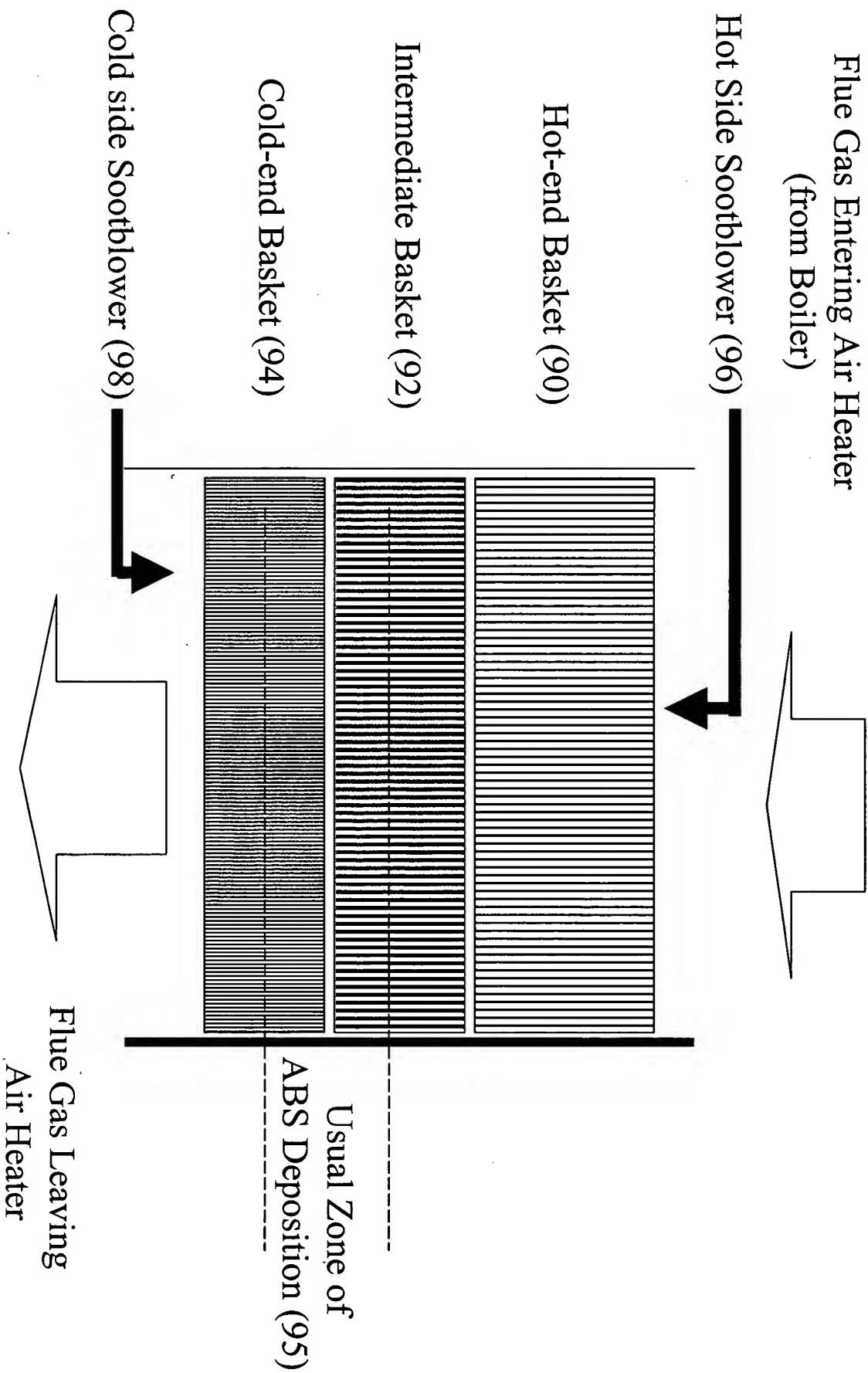


Figure 8: Detail of Heat Exchange Surfaces



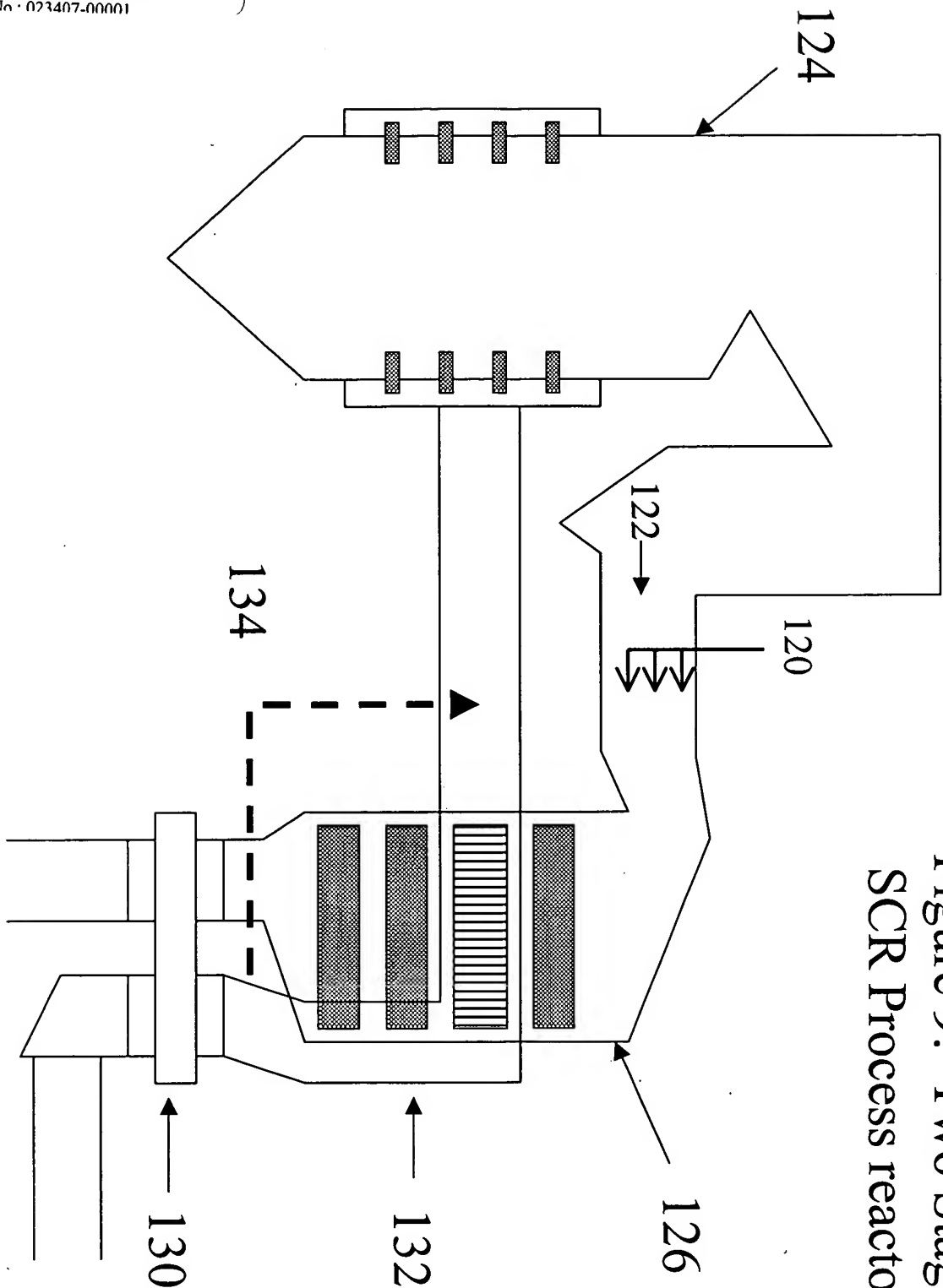
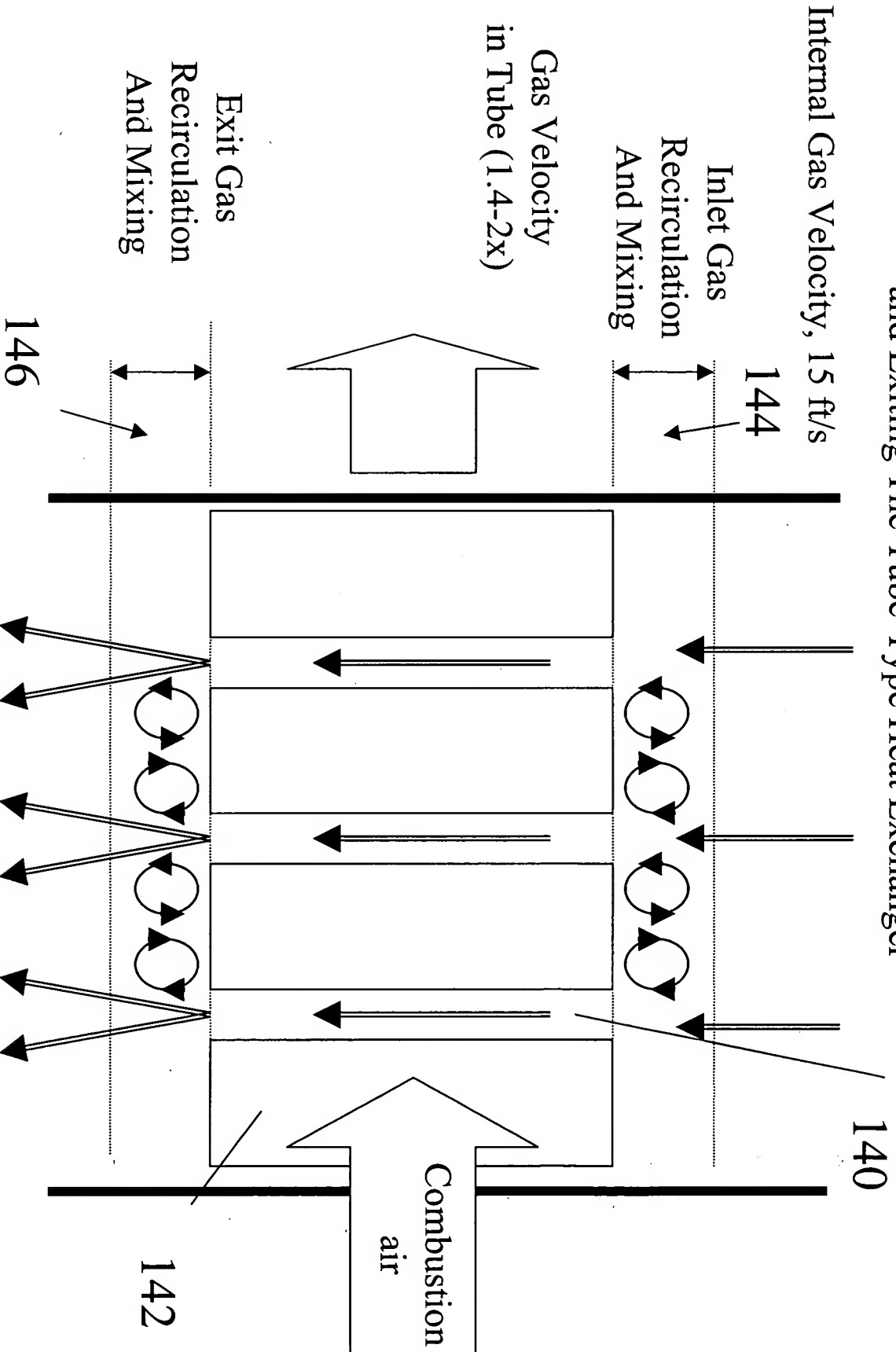
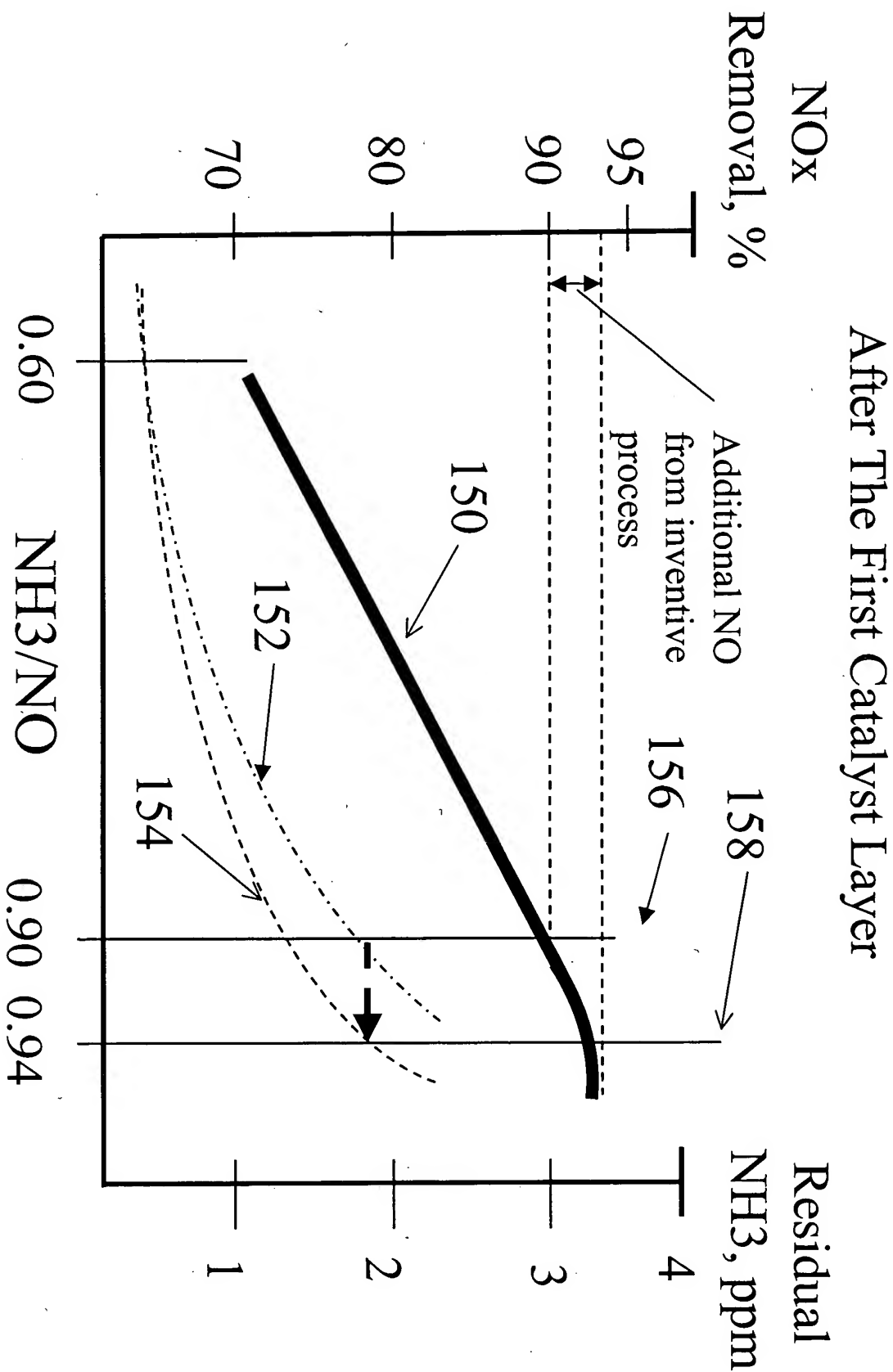


Figure 9: Two Stage
 SCR Process reactor

Figure 10: Flue Gas Flow Entering
and Exiting The Tube-Type Heat Exchanger





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FIGURE 12: SCR PROCESS CONDITIONS ACROSS THE REACTOR
AND EACH OF THREE CATALYST LAYERS

| | NOx Removal (%) | Residual NH3 at Nox Reduction, ppm | | Standard Deviation At Entrance to Reactor or Layer (%) | | Flue SO3 (ppm) | | ABS Onset Temp, F | |
|----------------------|-----------------|------------------------------------|-------------------|--|-------------------|---------------------|-------------------|---------------------|-------------------|
| | | Conventional Design | Inventive Process | Conventional Design | Inventive Process | Conventional Design | Inventive Process | Conventional Design | Inventive Process |
| Process Inlet | | n/a | n/a | 5% | 5% | 15 | 15 | 575 | 575 |
| Layer 1 | | | | | | | | | |
| Across | 68% | | | | | | | | |
| Exit | | 50 | 45 | 15% | 10% | 21 | 21 | 450 | 400 |
| Layer 2 | | | | | | | | | |
| Across | 19% | | | | | | | | |
| Exit | | 12 | 7 | 36% | 20% | 31 | 25 | 430 | 375 |
| Layer 3 | | | | | | | | | |
| Across | 3% | | | | | | | | |
| Exit | | 6 | 2 | 47% | 28% | 45 | 29 | 375 | 360 |

Figure 13. Relative Oxidation of Hg and SO₂

Hg Oxidation

SO₂ Oxidation

